Smart Mobility Driving Tomorrow's Society

Connected Autonomous Public Personal Mobility is required on future mobility society !

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Automotive Summit 2019, BITEC, Bangkok, on June 20, 2019

NU-CAR

Self introduction

– Career –

- April 1978 Toyota Motor Corporation
- April 1983 – March 1986 Toyota Europe Representative Office ; Brussels
- January 1999 General manager
- July 2011 Professor; Nagoya University
- April 2019 Senior Researcher; Nihon University

– Major experiences in Toyota –

- 1980～1999 Vehicle Dynamics; Driving and Comfort Performance
  - Corolla, Celica, Supra, Cressida, Lexus, Land Cruiser, etc.
- 1986～2002 Research and Development of Vehicle Dynamics, New Suspension system
- 2003～2011 Future Mobility and Advanced Technology
- 2008～2011 Head of "Ultra Low Fuel Consumption Vehicle Project"

– Awards –

- 1996 FISITA (International Society of Automotive Engineers)
  - Outstanding Paper Award

"Analysis of the Braking Performance of Straight-Running Vehicles on Uneven Roads"

– Invited Lectures –

- 2005 IRC (International Rubber Conference) Keynote lecture
- 2010 IISRP (International Society of Rubber Industries) Invited lecture

Start as a Vehicle Dynamicist (39 years ago)

講談社 ヤングマガジン編集部 2009-07-06

TOYOTA

TOYOTA ▸ AE86

[TOYOTA AE86開発者Interview]

原口哲之理

数奇な運命の末に誕生 伝説のFRスポーツ、ハチロク

ラインオフからすでに四半世紀。それでもハチロクを語るファンの熱い想いは決して冷めることはない。発動の名車の素顔を、当時の開発者のひとり、原口哲之理氏に聞いた。

Tetsunori Haraguchi

最後のFRレビン/トレノを造る。開発首脳全員がそれを知っていた

――開発に携わったエンジニアの一人として、原口さんは現在のハチロクブームをどう感じていますか？

原口　面食らうというか、『頭文字D』の影響なんでしょうね、まわりからいろいろと聞こえてきます。"損得走り"とかを筆頭に、既視していたときには、こんなふうにマンガの重要なキャラクターになるとは想像もできなかったですよ。エンジニアはそのクルマができあがってしまえば手から離れてしまうわけですが、クルマは社会に出てお客様に育てられるわけですね。時代の流れのなかで忘れられてしまうクルマもあります。そういう意味ではハチロクはあれから何十年も経ってもまだ成長している凡てね。これはすごいことだなと思います。

――原口さんはハチロクの開発にどのよう

なかたちで関わられたのでしょうか？

原口　実は私がトヨタに入社して本格的に開発に携わった最初のクルマが初代カローラ/スプリンター。なんです。当時の第11次開発という部署で操安性の開発を担当していました。ちょうどカローラ/スプリンターをFF化するタイミングで、人手が足りない。オマエ、コッチに来いという感じですか。これも巡り合わせだと思うんですけれど、80年はFFとFRの両方を同じ部署で受け持ったんです。初めてA4GエンジンがFF車を走らせたときには、とんでもないなと思いましたね。とにかくジタバタ系で、当時としてはパワーもありましたし、困ったなと思う。だからFRのハチロクについてはそれほど心配していなかったですね。

――当時、他メーカーに比べてトヨタは大衆車のFF化が遅れていました。80年からFF化が本格化するわけですが、このとき全面的にFFにせず、スポーティなレビン/トレノはFRで残していきます。何か特別な理由があったのでしょうか？

原口　80年ですでに3ドアという前置きのエンジン*をFRで積んでいましたから、その発展形で最初からAA6と組み合わせてFRでレビン/トレノを造るという考えだったと思います。これは私の勝った考えですが、損得勘定ラインや工場をFRとFFで変えてしまうのにはリスクもあるし、あるものを活かして良いクルマができないかという発想もあったのではないかと思います。

――開発目標はどんなところにあったのですか？

原口　上からは速いクルマを造れと言われましたが、これが最後のFRのレビン/トレノになるということは開発部隊の全員が知っていましたからね。ブレッシャーではないけれど、速くておもしろいクルマを造ろう、そうした自負みたいなものはみんなが共有していましたね。

ライバルはランサーEvo。筑波ラップ、16秒が目標だった

⇒ AE86”Hachiroku” was the final FR Corolla GT and had become a “Legendary” vehicle.

Most Aggressive Age (30 years ago)

TOYOTA

MotorFan

⇒ ”Top Guns” were three test drivers specially designated in Toyota.

Ultra efficient concept vehicle ~FT-Bh ~

Toyota FT-Bh Geneva Motor Show 2012

Fuel Consumption is Half ! of Prius2003

Contribution to fuel consumption on NEDC (New European Driving Cycle)

	Base case		Studied case	**Fuel** consumption
Curb mass	1200 kg		800 kg	
Gross **mass** with 2 occupants	**1350 kg**	⇨	**950 kg**	**-14.6%**
Tire **RRC**	**100×10^{-4}**	⇨	**60×10^{-4}**	**-10.6%**
Overall length	3785 mm		3785 mm	
Overall width	1695 mm		1695 mm	
Overall height	1520 mm		1435 mm	
Frontal **area**	**0.22 m^2**	⇨	**0.20 m^2**	**-2.7%**
Coefficient of aero **drag**	**0.26**	⇨	**0.23**	**-2.7%**
Engine displacement	1496 cc		996 cc	
Transaxle	THS II		THS II	
Averaged system **efficiency** (hybrid system inclusive)	**37.5%**	⇨	**45%**	**-18.9%**
Drive configuration	FF		FF	

Base case is a current mass-produced compact car in B segments plus hybrid power train system hypothetically.

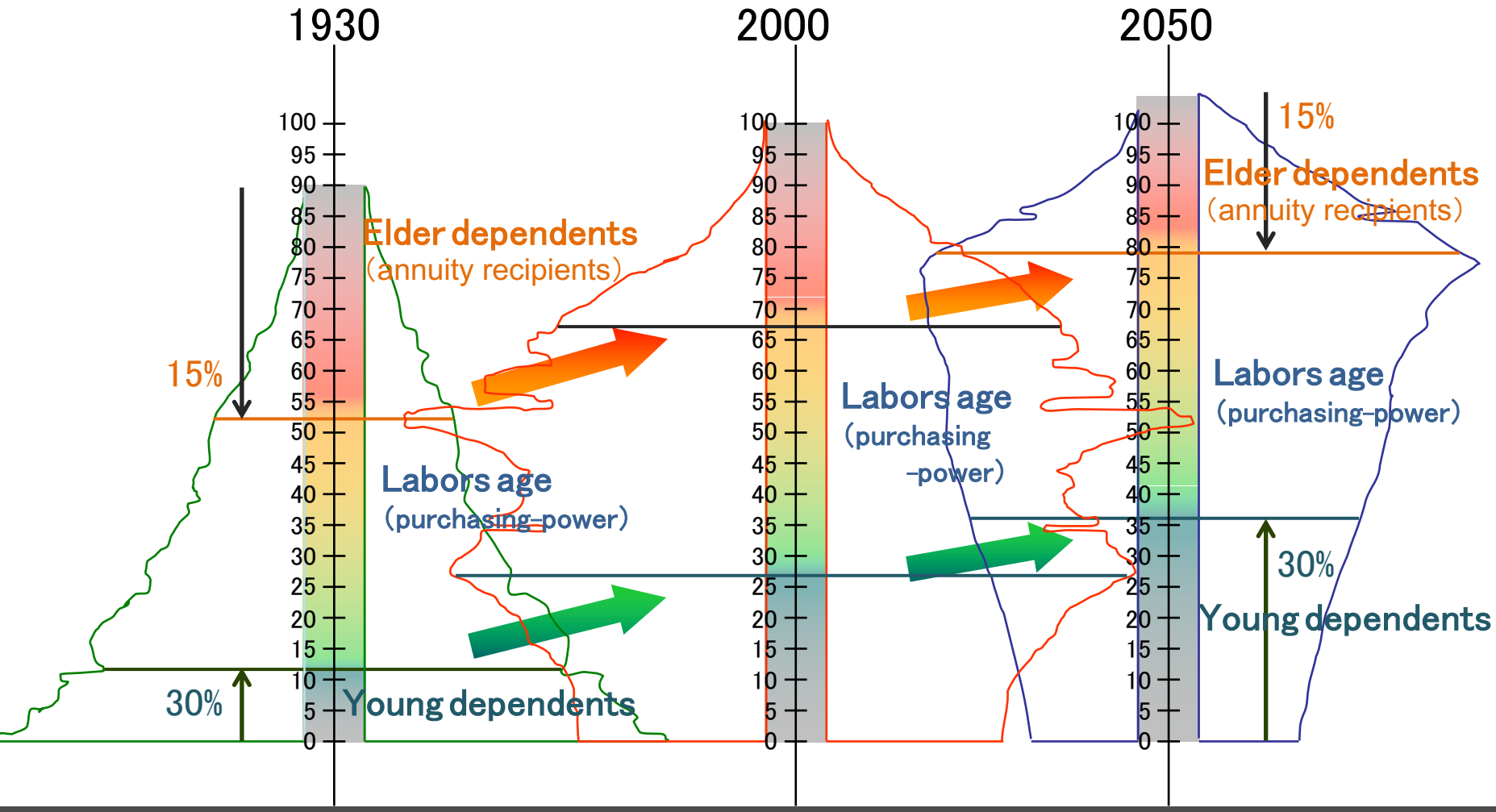
Toyota FT-Bh Geneva Motor Show 2012

⇒ FT-Bh emits only 49gr/km CO_2.

Today's Topics

- *Background*
  - *Decreasing birthrate and Aging population*
  - *Requirement on 21st Century Mobility*
- *Approaching to the true cause by "Why, Why, Why…"*
  - *Is mass transportation really high efficiency?*
  - *Is ride sharing really the needs of users?*
- *Innovation*
  - *Innovative Mobility Society requires Driverless Transportation.*
  - *Innovative Mobility Society requires Behavioral Predictions.*
  - *Anytime, from Anywhere, to Anywhere*
- *Personal Mobility Vehicles; Public Personal and Use for Free*

Decreasing birthrate and Aging population



⇒ Required labors age to maintain the macro-economy should be shift to older.

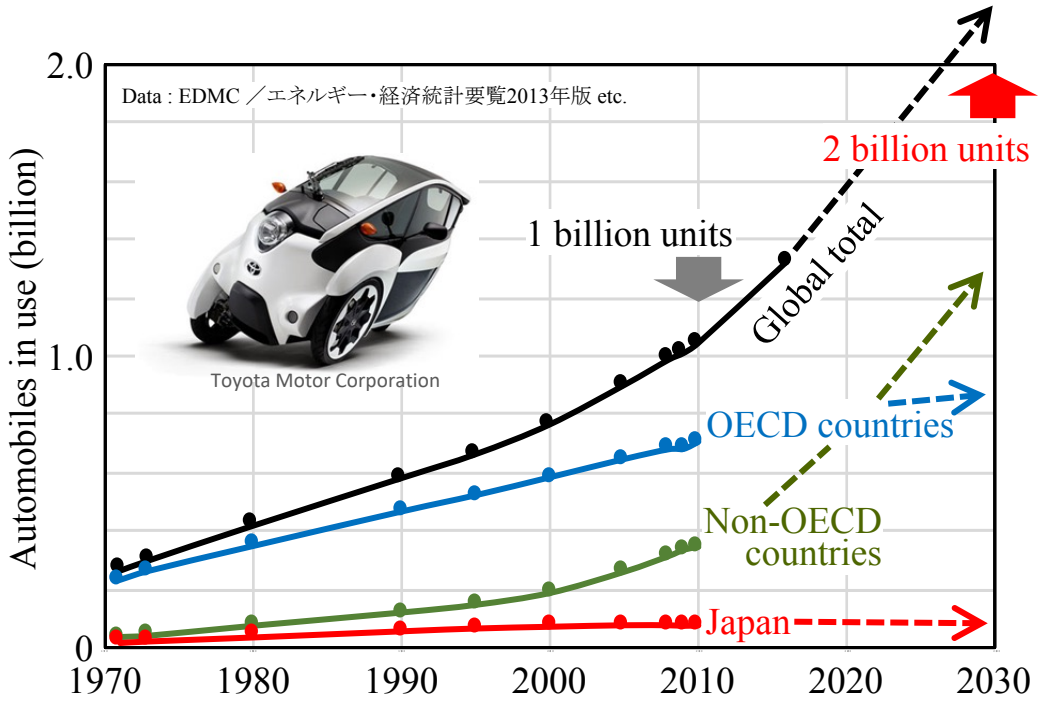
Decreasing birthrate and Aging population

- *Decreasing birthrate and aging population*
- *Required labors age to maintain the macro-economy should be shift to older.*
- *Future society requires support by innovative mobility system, for young generation to continue to be students.*
- *Future society requires support by innovative mobility system, for elderly generation to continue on active duty.*

This could not be originally a social problem from the viewpoint of age distribution.

⇒ Required labors age to maintain the macro-economy should be shift to older.

Requirement on 21st Century Mobility



- Restriction on private ownership？
- **Ultra Small Electric Vehicle！**

Negative prospect on resource supply
- Metals（steel, etc.）
- Chemical materials
- Natural rubber

Negative prospect on infrastructure
- Road
- Parking
- Energy supply

Typical usage in residential district
- Everyday
- Short distance

⇒ “Ultra small” is the necessary trend on rapid increase of global automobile number in use.

Requirement on 21st Century Mobility

- *Resource crisis and difficulty on infrastructure*
- *Ultra smaller mobility should be comfortable for citizens and smart solution for government official.*
- *Future society requires that mobility system is innovatively and drastically efficient.*
- *Future society requires that upcoming mobility is innovative and desired by widely citizens.*

Developed country shows sustainable mobility society with required future mobility.

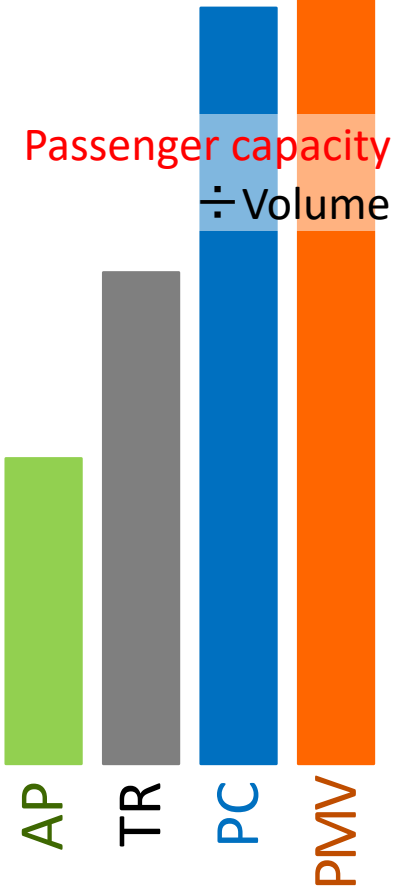
⇒ “Ultra small” is the necessary trend on rapid increase of global automobile number in use.

“Public personal ultra-small mobility” was proposed toward upcoming future.

Is mass transportation really high efficiency?

AirPlane (B787-8) / TRain (N700) / Passenger Car (Crown Comfort) / Personal Mobility Vehicle

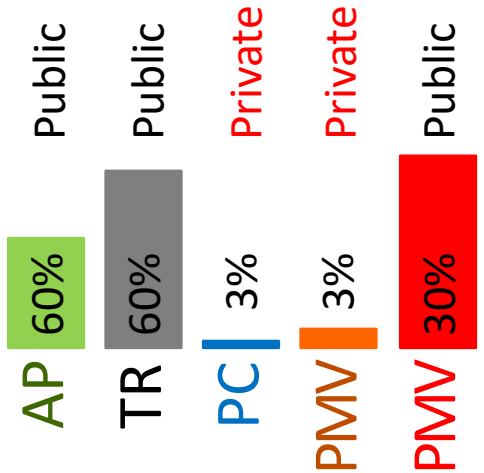
Passenger capacity
÷ Volume



Toyota Motor Corporation

× Occupancy rate

× Frequency in use



⇒ Although mass transportation makes efficiency better on driver, it makes efficiency worth on Energy.

“Public personal ultra-small mobility” was proposed toward upcoming future.

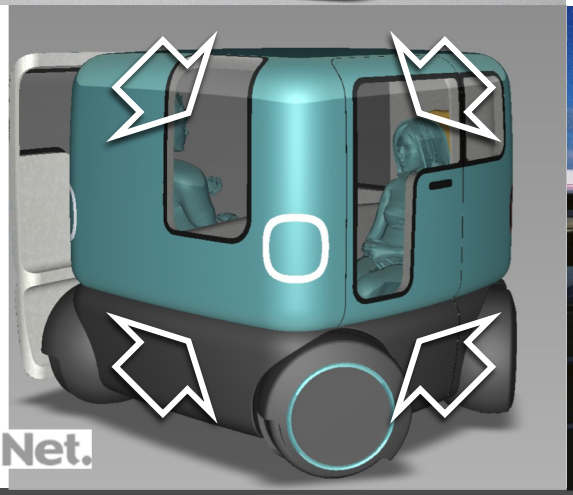
Is ride sharing really the needs of users?

No projection engineers to use Smartphone

⇒ No need to share privacy with others

No drivers on Ultra Small Cubic Mobility

⇒ No needs to share ride with others

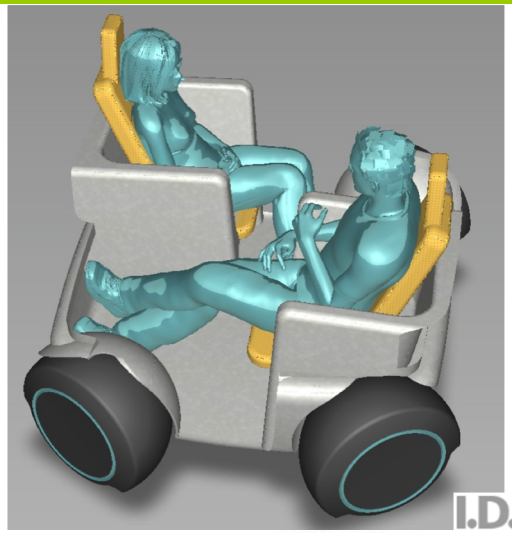


⇒ Secure privacy, then anytime, from anywhere, to anywhere …

Explosive popularization of efficient mobilities is the key solution on Global warming.

Society requires Driverless Transportation

Benefits and Fun, citizen cannot release



Type Ⅰ : Ultra small full autonomous driving mobility
→ Social infrastructure, free to use
→ Anytime, from anywhere, to anywhere
→ Secure privacy

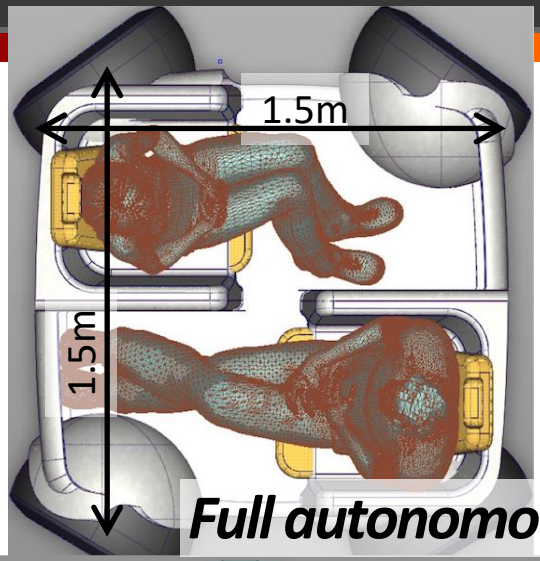
Type Ⅱ : Sense of unity like a part of the body
→ Narrow width, Tilting inward on turning
→ Designated driving lane（Free from congestion）
→ Designated parking lots, Road side parking allowed（Easy Parking）

Toyota Motor Corporation

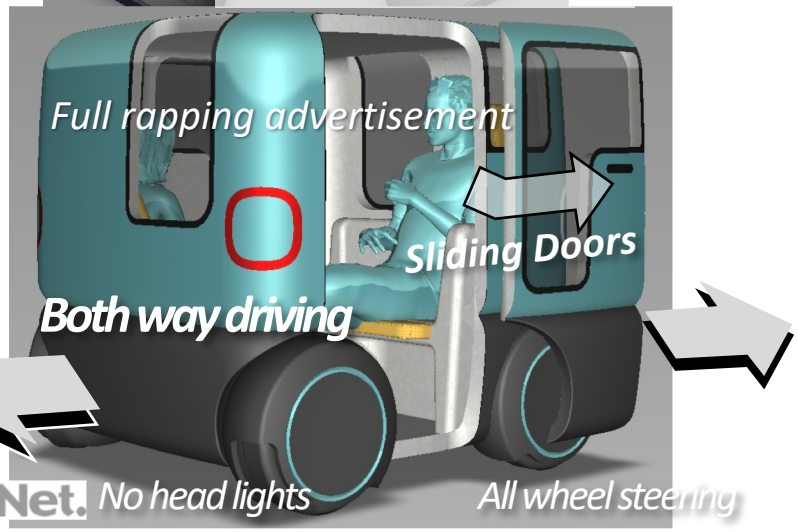
⇒ Popularization is essential as environmental solution.

Explosive popularization of efficient mobilities is the key solution on Global warming.

Public Personal Mobility



Full autonomous



K-car standard (Sep. 1996)
Length: 3.50m
Width : 1.48m

Current K-Car

DAIHATSU

⇒ Upcoming future; Cubic mobility comes without calling, starts without ordering.

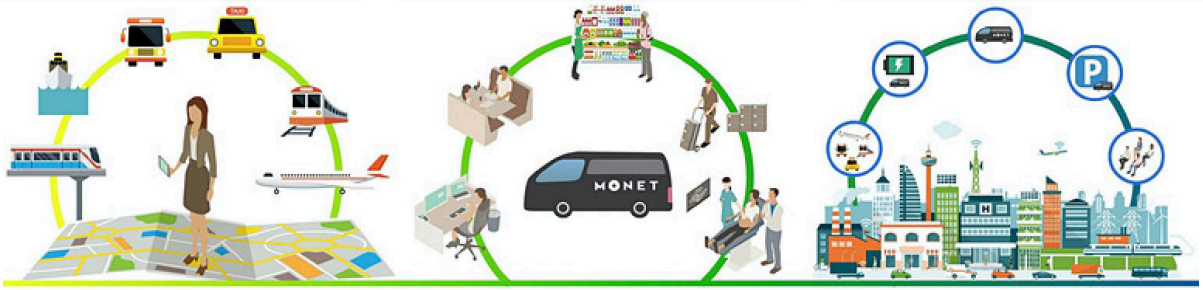
Society requires Behavioral Predictions

- *Full Autonomous is the core solution not only on driver point of view but also on privacy point of view.*
- *Connected is the core solution on customers satisfactions and explosive popularization.*

Example;

MONET Technologies Inc.

1. Advancement of existing traffic
2. Creation of new lifestyle
3. Optimization of total society



MONET platform

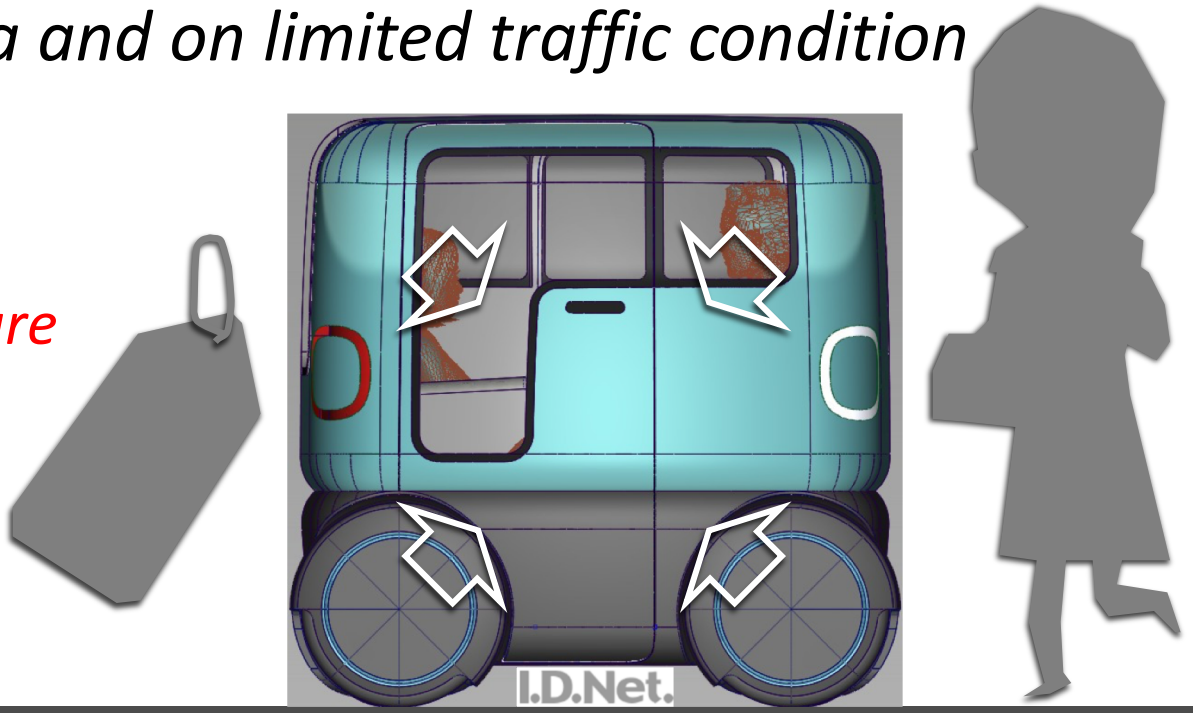
⇒ Connected, Autonomous, Shared & Services, Electric

Explosive popularization of efficient mobilities is the key solution on Global warming.

Anytime, from Anywhere, to Anywhere

- *"Free" last one mile mobilities as the infrastructure*
- *10 times higher frequency in use than private cars*
- *Ultra small vehicles with "level 5" autonomous driving in limited area and on limited traffic condition*

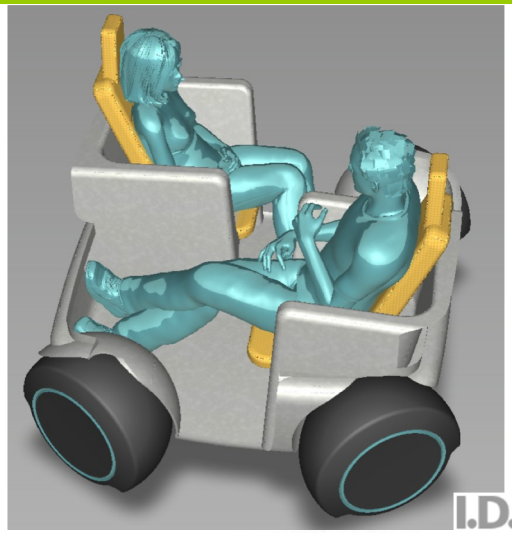
- *Social infrastructure*
- *Free to use*
- *Full autonomous*



⇒ Annual budget is JPY 2 trillion to deliver 5 million Cubics to replace 50 million private cars.

New mobility culture creates lively society

Benefits and Fun, citizen cannot release



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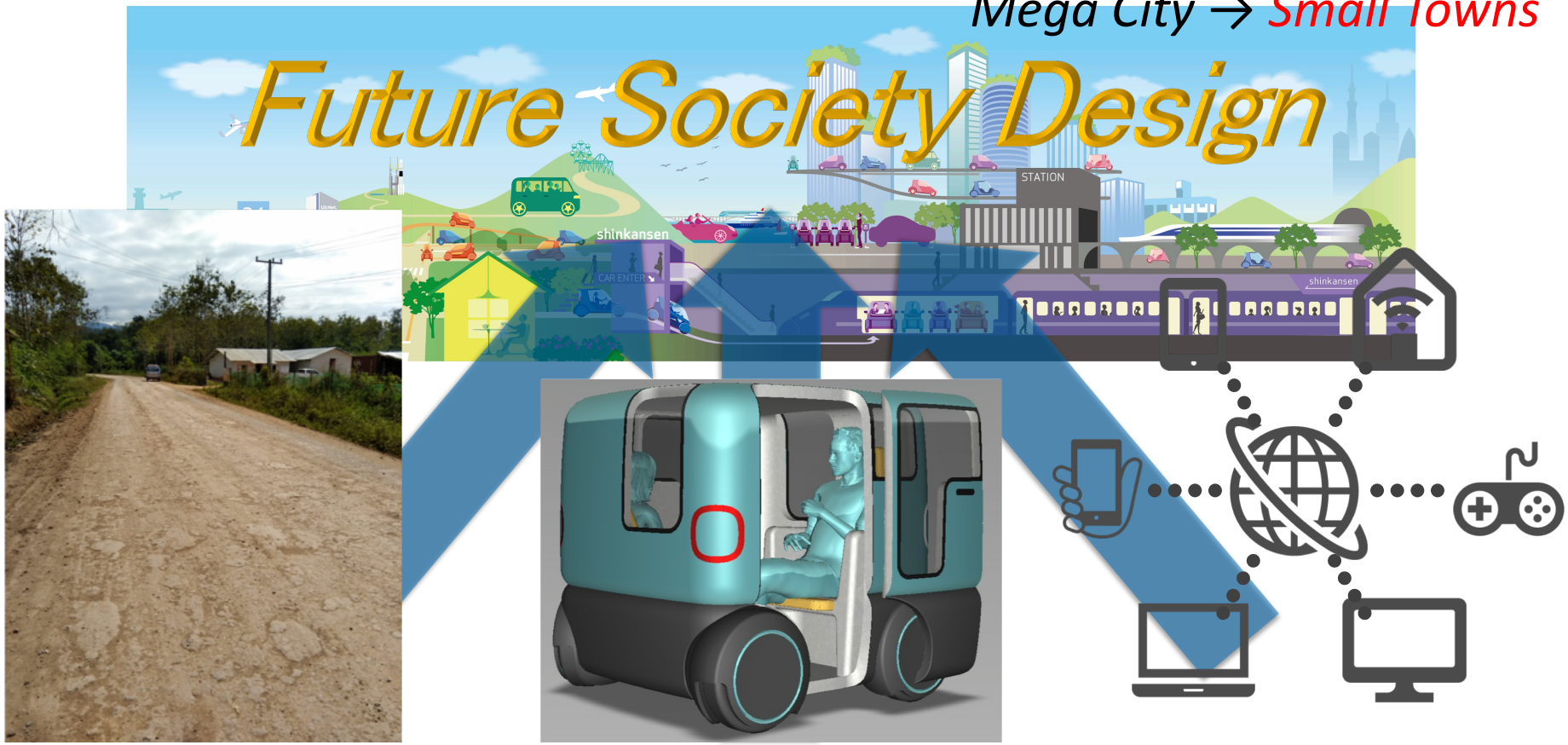
Special service, Desire to own, Fun to drive

Toyota Motor Corporation

⇒ New mobilities, citizen cannot release, make explosive popularization.

PMV; Public Personal and Use for Free

Mega City → Small Towns



Free Road　Free Mobility　Free Information　Free Network

⇒ Society guarantees the right to move basically and the right to access basic information